The Impact of International Travel on the Epidemiology of Enteric Infections, British Columbia, 2008

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ABSTRACT

Objective: Travel-related enteric infections likely represent a large proportion of all enteric infections in British Columbia (BC). The objective of this study was to assess the proportion of enteric infections in BC reported in 2008 associated with international travel in order to understand trends in infections so that targeted interventions can be implemented.

Methods: Travel information for all reported cases of salmonellosis, verotoxigenic *E. coli* (VTEC) infection, shigellosis, *Vibrio parahaemolyticus* infection, botulism, cholera, listeriosis, typhoid fever, paratyphoid fever, hepatitis A infection, cryptosporidiosis, cyclosporiasis and a representative proportion of campylobacteriosis was collected. Temporal, demographic and geographic analysis was conducted comparing locally-acquired infections to infections acquired during international travel. Travel destination was compared between cases of enteric infections and the BC population.

Results: Of the 3,120 enteric infections reported in 2008, 60% were classified as locally-acquired and 40% were associated with international travel. The proportion of infections associated with international travel was highest among 30 to 39 year olds. Locally-acquired infections were highest in the summer months and international travel-related infections were highest in the winter. Asia and Mexico were the most common destinations in relation to enteric infections acquired internationally. The proportion of enteric infections was significantly higher than the proportion of the BC population travelling to these areas.

Conclusions: The proportion of enteric infections in BC associated with international travel is significant. Identification and assessment of locally-acquired infections separately from those associated with international travel will improve assessment of trends and rates for enteric infections in BC and lead to more targeted public health actions.

Key words: Travel; epidemiology; gastroenteritis; infection; Canada

La traduction du résumé se trouve à la fin de l'article.

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A significant proportion of enteric infections in developed countries have been associated with international travel. In Sweden, 54% of *Campylobacter* infections notified over a 7-year period were linked to travel outside of Sweden.¹ A pilot study conducted in an urban region of British Columbia (BC) demonstrated that 38% of enteric infections reported between 2002 and 2006 were associated with international travel.²

In BC (population 4,381,603), identification and exclusion of travel-related infections from analysis is necessary to assess the burden, temporal and geographic trends of locally-acquired infection and identify local sources and risk factors for enteric infections in order to prevent and control them. Additionally, understanding the epidemiology of enteric infections acquired internationally may help to direct actions and education for travelers.

The goal of this research was to assess the proportion of enteric infections in BC reported in 2008 that was associated with international travel in order to better understand local infection trends. This report describes the temporal, geographic and demographic features of infections acquired locally and compares them with those acquired internationally.

METHODS

Laboratory-confirmed cases of reportable enteric infections are reported to public health authorities. Individuals with such infections reported between January 1 and December 31, 2008 were interviewed by environmental health officers in BC using standard

forms* to collect travel information. All infections of salmonellosis, verotoxigenic *E. coli* (VTEC), shigellosis, *Vibrio parahaemolyticus*, botulism, cholera, listeriosis, typhoid fever, paratyphoid fever, hepatitis A, cryptosporidiosis, and cyclosporiasis were included. Since the number of campylobacteriosis infections is high and they are not routinely interviewed in BC, only a representative proportion was interviewed and included. Infections of campylobacteriosis were sampled to maintain seasonal variation. Monthly targets were set based on expected incidence from 2002 to 2006 for each regional health authority. Cases were selected systematically (e.g., every second case) in order to meet this target.

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* Available at: <http://www.bccdc.ca/dis-cond/CDSurveillanceForms/default.htm#heading2> (Accessed November 2009).

Table 1. Number, Rate, Proportion and Location of Acquisition of Enteric Infections, January 1-December 31, 2008, BC

Infection	Number of Infections	Rate/100,000	Number with Travel Information Available	Number of Unconfirmed International Travel Infections (%)	Number of Confirmed International Travel Infections (%)	Number of Locally-acquired Infections (%)
Campylobacteriosis	1646	37.6	1005	45 (4.5)	273 (27.2)	687 (68.4)
Cholera	2	0.0	2	0 (0.0)	2 (100.0)	0 (0.0)
Cryptosporidiosis	118	2.7	73	11 (15.1)	24 (32.9)	38 (52.1)
Cyclosporiasis	32	0.7	27	8 (29.6)	17 (63.0)	2 (7.4)
Verotoxigenic <i>E. coli</i> infection	114	2.6	98	12 (12.2)	17 (17.3)	69 (70.4)
Hepatitis A	39	0.9	34	7 (20.6)	12 (35.3)	15 (44.1)
Listeriosis	22	0.5	19	1 (5.3)	3 (15.8)	15 (78.9)
Paratyphoid Fever	29	0.7	29	6 (20.7)	21 (72.4)	2 (6.9)
Salmonellosis	845	19.3	713	71 (10.0)	202 (28.3)	440 (61.7)
Shigellosis	203	4.6	145	13 (9.0)	88 (60.7)	44 (30.3)
Typhoid Fever	48	1.1	46	6 (13.0)	38 (82.6)	2 (4.3)
<i>Vibrio Parahaemolyticus</i> infection	22	0.5	19	3 (15.8)	4 (21.1)	12 (63.2)
Total	3120	71.2	2210	183 (8.3)	701 (31.7)	1326 (60.0)

Each case was classified as having international travel (travel outside of Canada), travel within Canada (including BC) or no travel (no travel outside the health authority of residence). The “no travel” and “travel within Canada” categories were combined to represent locally-acquired infections.

Acquisition during international travel was deemed confirmed if, for infections not endemic to BC (typhoid and paratyphoid fever, cholera, cyclosporiasis, infections of *S. dysenteriae*), individuals had travelled to an endemic area during at least part of the incubation period or had travelled to a non-endemic area outside of Canada for the *entire* incubation period. For all other enteric infections, international acquisition was deemed confirmed if individuals travelled outside of Canada for their *entire* incubation period.* Only infections confirmed as acquired during international travel were included in the demographic and destination analysis.

Individuals with multiple infections or multiple episodes of the same infection reported more than 6 months apart were counted as separate infections. If the episodes with the same infection were within 6 months of each other, case information was reviewed to determine if the episodes were different based on available information. If no exposure information was available for an infection, the exposure was coded as “missing”. If the exposure information did not include information on travel but did identify other exposures (e.g., household exposure), the case was classified as “no travel”.

Case data and travel status were entered into an electronic system locally and transferred electronically to the BC Centre of Disease Control (BCCDC). Data were extracted in April 2009.

Seasonality was assessed for specific diseases for which there was a large enough number of infections.

Travel destinations for cases of enteric infections were compared to travel destinations of the general BC population from the 2006 International Travel Survey,³ which included all overnight visits by BC residents to international travel destinations, excluding the United States.

Data were analyzed using Microsoft Access 2003, Microsoft Excel 2003 and EpiCalc 2000 (version 1.02). Chi-square tests were used to compare proportions and a p-value of <0.05 was considered significant. 95% confidence intervals were calculated to compare the pro-

Table 2. Comparison of Travel Destinations for BC Residents (2006) and Enteric Infections Associated with International Travel (2008)

Destination	Proportion of BC Residents with Travel to Destination (%)	Proportion of Enteric Infections with Travel to Destination (%)	P-value
Europe	42.3	6.9	0.00
Africa	3.7	6.8	0.00
Asia	27.3	39.8	0.00
Central America	0.8	2.2	0.01
Caribbean	6.9	7.0	0.94
South America	1.5	6.8	0.00
Oceania	5.4	1.0	0.00
Mexico	12.0	23.4	0.00
US	—*	4.4	

* US travel data not available for BC residents

portion associated with travel to that locally-acquired, by age group. Population data were obtained from BC Statistics.⁴

RESULTS

A total of 3,120 enteric infections were reported during the study period. Overall, 2,210 (70.8%) infections had travel exposure information available. Infections of cholera, paratyphoid and typhoid fever had the most complete travel information (100%, 100% and 96%, respectively), whereas infections of cryptosporidiosis and shigellosis had the lowest (62% and 71%, respectively) (Table 1).

Of the 2,210 infections with travel information available, 1,326 (60.0%) infections were classified as locally-acquired; of the locally-acquired, 54.0% had not travelled outside of their health authority of residence and 133 (6.0%) had travelled within Canada. International travel accounted for 40.0% (n=884) of all enteric infections; 701 (31.7%) had confirmed international travel (Table 1). Cholera, typhoid fever, paratyphoid fever and cyclosporiasis had the highest proportion of infections associated with international travel (Table 1).

The proportion of illness associated with confirmed international travel varied from 26.0% to 45.2% for the different age groups and was highest among 30 to 39 year olds. The proportion of locally-acquired infections varied from 54.8% to 74.0%, and was highest among those 60 years and older (Figure 1). The proportion of locally-acquired infections was significantly higher than infections associated with international travel for all age groups except for those aged 30-39 (p<0.05).

Between January and April, the number of all infections with confirmed international travel was higher than those that were

* The exposure periods used were: salmonellosis-3 days, VTEC-10 days, shigellosis-4 days, *Vibrio parahaemolyticus* infection-3 days, botulism-3 days, cholera-2 days, listeriosis-70 days, typhoid fever-21 days, paratyphoid fever-10 days, hepatitis A-50 days, cryptosporidiosis-12 days, cyclosporiasis-14 days and campylobacteriosis-10 days.

Figure 1. Proportion and 95% confidence intervals of confirmed international travel and locally-acquired infections by age group, January 1-December 31, 2008, BC **Figure 2.** Enteric infections acquired during international travel and locally-acquired by month reported, January 1-December 31, 2008, BC

locally-acquired. For the remaining months, the number of infections that were locally-acquired was higher (Figure 2). Patterns for salmonellosis and campylobacteriosis were similar to overall enteric trends.

Among infections that were associated with international travel, the most common destinations were Asia (40%) and Mexico (23%) (Table 2). Further regional assessment for travel to Asia identified that 61.7% of confirmed travel-related infections were among travelers to South Asia, 26.3% of infections were acquired in Southeast Asia and 9.1% of infections were acquired in East Asia. Asia was the most common destination for acquisition of campylobacteriosis (37%), cholera (100%), cryptosporidiosis (49%), paratyphoid fever (100%), shigellosis (54%), typhoid fever (89%) and *Vibrio para-*

haemolyticus infection (71%). VTEC (52%), hepatitis A infection (48%), listeriosis (50%) and salmonellosis (31%) were most commonly reported after travel to Mexico and cyclosporiasis (48%) was most commonly reported after travel to South America.

The proportion of infections associated with travel to Europe and Oceania was significantly lower than the proportion of the general BC population who travelled to these destinations. However, the proportion of infections associated with travel to all other destinations, besides the Caribbean, was significantly higher among enteric infections ($p < 0.05$).

Among campylobacteriosis cases, the proportion associated with travel to Africa, Asia (majority to South and Southeast Asia), South America and Mexico was significantly higher compared to that in

the general population of BC. For infections with VTEC, the proportion of travelers to South America and Mexico was significantly higher; among salmonellosis cases, the proportion was significantly higher for travelers to the Caribbean and Mexico; and among shigellosis cases, the proportion was significantly higher among travelers to Africa, Asia (majority to South Asia), Central America and South America.

CONCLUSIONS

Based on this study, 31.7% of enteric infections in BC were associated with international travel in 2008. For specific enteric infections, this ranged from 16% to 100%. To our knowledge, this is the first provincial assessment of the impacts of international travel on the epidemiology of enteric infections that has been published from North America.

Notably, 20-30% of common endemic infections (salmonellosis, campylobacteriosis and VTEC) were associated with international travel. Other studies have also documented associations between enteric infections and travel.⁵ In BC, a study of risk factors for hepatitis A identified that 26% of infections reported between 1998 and 2004 were acquired through travel to another country.⁶ Previous work in New Zealand demonstrated a significant association between infections of shigellosis and salmonellosis and overseas travel.⁷ Four studies from Sweden showed that the proportions of typhoid fever and paratyphoid fever associated with international travel (79% and 86%, respectively) are comparable to our results, whereas the proportions of campylobacteriosis (54%) and non-typhoidal salmonellosis (78%) associated with travel were higher in the Swedish studies. This may be due to a difference in travel habits whereby Europeans frequently travel to countries within Europe that may have higher rates of enteric infections than Sweden.^{1,8-10} Compared to the Swedish study, the proportion of shigellosis infections associated with international travel in our study was higher at 60%. This proportion may be an over-estimate as the travel status for shigellosis was not as complete in our analysis. Further assessment by *Shigella* species may help understand these trends, but was not possible due to data limitations.

Adults between the ages of 30-39 years had the highest proportion of infection associated with international travel. According to Statistics Canada, individuals between the ages of 45 and 64 most frequently travel overseas.¹¹ The higher proportion of illness in the younger age range may suggest that this is a group that: may not seek medical advice prior to travel; travels to higher-risk areas; is less likely to take precautions in regards to food and drink; or participates in higher-risk activities while traveling. Alternatively, older adults, who do the majority of travel, may be less likely to seek medical attention due to their frequency of travel and tolerance for enteric symptoms. Locally-acquired infections were more common in all age groups compared to those acquired during international travel, however the proportion of locally-acquired illness was highest among those 60 years and older and those less than 19 years. This pattern is typical of enteric illness, which has a higher incidence and severity in the elderly and young children – two groups who may also be more likely to seek medical attention. Travel medicine advice and counseling may need to be adapted to formats more likely to reach young adults, such as the use of travel websites and social networking tools.

There were clear seasonal trends in our findings, consistent with the seasonality of travel from Canada; during the winter, people take holidays and visit friends and family in warmer destinations,¹¹ whereas during summer, people travel locally or to Europe. Historical BC data suggest that most enteric infections peak through the summer months and this analysis identified that the majority are locally-acquired.¹² The reason for this is uncertain and could be due to behavioural, ecological or food distribution patterns. Public health actions and messages related to local enteric exposures and risks may be most effective when communicated before the summer months. For travelers, health messaging may be most effective if communicated throughout the fall and early winter seasons. This could be through general public health messaging or tailored travel health advice.

The proportion of enteric infections associated with travel to Africa, Asia, Mexico, Central America and South America was significantly higher than the proportion of all BC visits to these countries. Improving awareness in travelers before they travel, particularly among young adults and those travelling to the aforementioned locations, would be valuable. Pathogen and destination trends may allow specific interventions to be put in place and may help us to better understand disease patterns. Our analysis showed that 4.4% of enteric infections were associated with travel to the US. Although comparison data were not available, it is likely that a much greater proportion of BC residents travelled to the US.

As this analysis only represents one year of lab-confirmed BC data, which did not include all enteric infections and for which travel information was limited for some infections, there are some limitations to the interpretation. However, the findings are comparable to other international studies and review of additional years of data is ongoing.

This study has shown that the proportion of enteric infections in BC associated with international travel is significant and can have an impact on the interpretation of trends, rates and burden of enteric infections in BC. For public health professionals, understanding the proportions and epidemiology for locally-acquired infections and those associated with international travel can impact the prioritization and types of public health actions and interventions taken to prevent infections in these two very different risk settings.

REFERENCES

1. Ekdahl K, Andersson Y. The epidemiology of travel-associated shigellosis—regional risks, seasonality and serogroups. *J Infection* 2005;51(3):222-29.
2. Macdougall L, Wood C, Li M. The Epidemiology of Travel-related Enteric Disease: Pilot Project, North Shore. 2007. Unpublished.
3. Statistics Canada. International Travel Survey. Ottawa, ON: Statistics Canada, 2007.
4. BC STATS, BC Ministry of Citizens' Services. Population Estimates (1986-2009) and Projections (2009-2036). Available at: www.bcstats.gov (Accessed November 2009).
5. Freedman DO, Weld LH, Kozarsky PE, Fisk T, Robins R, von Sonnenburg F, et al., and the GeoSentinel Surveillance Network. Spectrum of disease and relation to place of exposure among ill returned travelers. *N Engl J Med* 2006;354(2):119-30.
6. Pollock SL, Sheikholeslami A, Edgar B, David ST, Buxton JA. The changing epidemiology of hepatitis A in British Columbia: Using health authority follow-up data to inform policy and practice. *CCDR* 2006;32(20):239-44.
7. Wilson N, Baker M, Edwards R, Simmons G. Case-case analysis of enteric diseases with routine surveillance data: Potential use and example results. *Epidemiologic Perspectives & Innovations* 2008;5:6.
8. Ekdahl K, de Jong B, Andersson Y. Risk of travel-associated typhoid and paratyphoid fevers in various regions. *J Travel Med* 2005;12:197-204.
9. Ekdahl K, Andersson Y. Regional risks and seasonality in travel-associated campylobacteriosis. *BMC Infect Dis* 2004;4:54.

10. Ekdahl K, de Jong B, Wollin R, Andersson Y. Travel-associated non-typhoidal salmonellosis: Geographical and seasonal difference and serotype distribution. *Clin Microb Infect* 2005;11:138-44.
11. Statistics Canada. International Travel, 2007. Available at: <http://www.statcan.gc.ca/pub/66-201-x/2007000/t030-eng.htm> (Accessed October 22, 2009).
12. BC Centre for Disease Control. Annual Summary of Communicable Diseases. Vancouver, BC: BCCDC, 2008. Available at: <http://www.bccdc.org/content.php?item=33> (Accessed October 19, 2009).

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RÉSUMÉ

Objectif : Les infections entériques liées aux voyages représentent probablement une grande proportion des infections entériques en Colombie-Britannique (C.-B.). Nous avons cherché à déterminer la proportion des infections entériques déclarées en 2008 en C.-B. associées aux voyages internationaux pour mieux comprendre les tendances dans ces infections et permettre la mise en œuvre d'interventions ciblées.

Méthode : Nous avons recueilli des renseignements sur les voyages pour tous les cas déclarés de salmonellose, d'infection à *E.coli* producteur de vérotoxine (ECPV), de shigellose, d'infection par le vibrio parahémolytique, de botulisme, de choléra, de listériose, de fièvre typhoïde, de fièvre paratyphoïde, d'hépatite A, de cryptosporidiose et de

cyclospore, et pour une proportion représentative des cas de campylobactériose. Des analyses temporelles, démographiques et géographiques ont été menées pour comparer les infections contractées localement à celles contractées en voyage à l'étranger. Nous avons comparé les destinations de voyage pour les cas d'infections entériques et pour la population britanno-colombienne.

Résultats : Sur les 3 120 infections entériques déclarées en 2008, 60 % avaient été contractées localement et 40 % étaient associées à des voyages internationaux. La plus forte proportion d'infections associées aux voyages à l'étranger était observée chez les 30 à 39 ans. Les infections contractées localement atteignaient un sommet durant les mois d'été, et les infections liées aux voyages internationaux, durant l'hiver. L'Asie et le Mexique étaient les destinations internationales où l'on a le plus souvent contracté des infections entériques. La proportion d'infections entériques était sensiblement plus élevée que la proportion d'habitants de la C.-B. à voyager dans ces régions.

Conclusion : Une importante proportion d'infections entériques en C.-B. est associée aux voyages internationaux. En séparant l'identification et l'évaluation des infections contractées localement et des infections associées aux voyages internationaux, on pourrait améliorer l'évaluation des tendances et des taux d'infections entériques en C.-B. et mieux cibler les efforts de santé publique.

Mots clés : voyage; épidémiologie; gastroentérite; infection; Canada

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